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Industrial Production of Methanol

By WALLACE LLOYD BOSTWICK, CH.E. IV

METHANOL or methyl alcohol is commonly called wood alcohol or wood spirit since it was first produced in quantity by the destructive distillation of wood. It is a colorless liquid having a slight odor and its vapors are toxic. It has a fairly low boiling point, 66°C ., and is about 0.8 as heavy as water.

There are two principal methods in use now for the industrial production of methanol. One of these is the destructive distillation of wood and the other is a synthesis which utilizes carbon monoxide and hydrogen passing over a heated catalyst.

In the production of methanol by wood distillation the hardwoods such as beech, birch, maple, and thorn are the best since soft woods give off a great amount of tar when they are heated. Vinasse, a by-product of the sugar beet industry is also a source of methanol.

The wood used is generally seasoned for one or two years, divested of its bark, and cut into 50 inch lengths. The destructive distillation is carried out in large iron retorts at a temperature of 400° to 500°F . The retorts are usually made of steel and are provided with outlet tubes about 15 inches in diameter. They are set in pairs in brickwork and batteries of from two to twenty pairs are common. The wood is fed through a door and is carefully stacked so as to completely fill the retort. In some large installations the retorts are made of brick and are of about 50 cords capacity. The wood is run into these retorts on steel cars and the retorts are closed. The retorts are heated from below with burning wood, coal, charcoal, or sometimes natural gas. This fuel is supplemented by the tar, oil, and gas obtained as byproducts of the industry if it is not desirable to use them for some other purpose.

The gaseous products of the distillation are passed through a condenser and the noncondensable gases are returned and burned under the retorts.

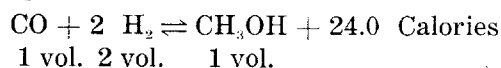
The liquid products are run into tanks and the tar is allowed to settle out. The pyroligneous acid, which contains the acetic acid, methanol, allyl alcohol, etc., forms the upper layer. This layer is dark red-brown in color and has a peculiar odor. It usually contains about 4 percent methanol.

The separation is effected by fractional dis-

tillation. To recover the acetic acid, the vapors are passed into milk of lime and grey acetate of lime is produced. Another method is to neutralize the pyroligneous acid before distilling off the methanol. Usually there are three distillations employed. There are produced distillates containing 15, 42, and 82 percent methanol from these three distillations. The last product, 82 percent methanol, still contains acetone and some other substances. By means of special methods of purification a more highly refined product containing 97 to 98 percent methanol can be produced.

The chief industrial uses of methanol are: one—starting material for formaldehyde, two—a denaturant for ethyl alcohol, three—in varnish manufacture, four—as a fuel, five—as a reagent in fine chemical and synthetic color industries such as the pharmaceutical and dye industries.

Synthetic methanol is produced by a method which is somewhat similar to the Haber Process for the production of ammonia. The reaction is reversible and consists of passing gaseous carbon monoxide and hydrogen over a heated catalyst under pressure.



From the equation it seems likely that under moderate pressure the reaction should follow the principle of Le Chatlier since there is a considerable decrease in volume. This will be only more true if the reaction is carried out at a reduced temperature since the reaction is exothermic. The reaction stated in the equation above is not strictly true since it represents only the tendency of the reaction to take place. There are side reactions which take place and form small amounts of formaldehyde, ethylene, and some other carbohydrates of the general formula $(\text{CH}_2\text{O})_n$.

The principle of van't Hoff which concerns the displacement of the equilibrium of a reaction was also found to have a profound effect upon the yield obtained. Under a pressure of 200 atmospheres, a temperature of 350° to 400°C ., and in the presence of a zinc oxide—chromic acid catalyst a yield of 90 percent was obtained. There were some traces of impurities in the methanol due to side reactions as was mentioned before.

The question of the catalyst to be used is very

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which is copper lined. On cooling, the outgoing gas permits liquefaction of the methanol formed. This liquid is then removed in a separator and the unconverted gases are then returned to the compressors and used over again. The conversion in this case is about 20 percent.

On distilling the synthetic methanol it is found to have a fraction of higher-boiling point alcohols. This has been explained.

In most cases the synthetic methanol is better than that made from wood since it is almost 100 percent CH_3OH . Also the synthetic product is much cheaper since there is no complicated purification process needed. In 1940 there were 24.1 million gallons of synthetic methanol produced. As a comparison to this there were 4.8 million gallons of wood alcohol produced.

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important and cannot be neglected. The yield of methanol and the repression of side reactions are affected by the catalyst. The metallic oxides and metallic salts such as chromates, manganates, vanadates, molybdates, and tungstates give good yields under certain conditions. Platinum and copper are also sometimes used.

The gas mixture may be 70 percent hydrogen and 30 percent carbon monoxide, or 80 percent hydrogen and 20 percent carbon monoxide, it may or may not contain small or large amounts of inert gas such as nitrogen, and the pressure may vary from 50 to 1000 atmospheres in different plants. The rate of travel through the converter or catalyst chamber must be timed in order to get the best conversion possible.

The gas must be free from sulfur, arsenic, and also carbonyls. The carbonyls might introduce iron if they were present, and this metal as well as nickel and cobalt must be avoided since they catalyze the formation of methane.

After the gases are compressed they must come in contact only with copper or aluminum surfaces. The converter is made of nickel steel



—Courtesy General Electric

Plastics are finding another job to do in the war as the small but vitally important parts, such as loop antenna housings, trench mortar fuse caps, magneto parts, and flashlight filters.

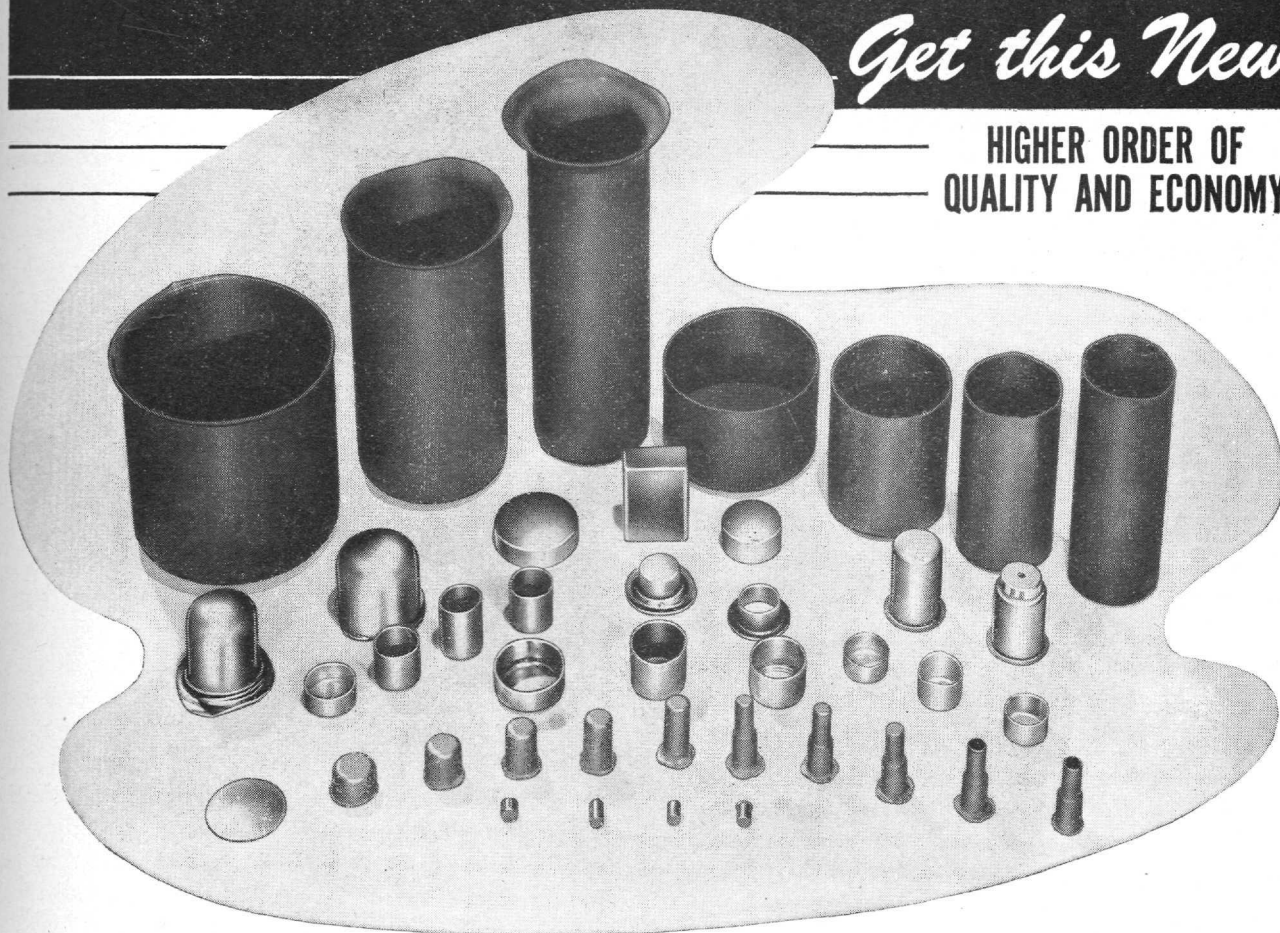
An interesting use of plastics' properties is found in the loop antenna housing enclosing the radio aerial on bombers. In the past the housings were made of a wood frame and cloth covers, but these were unsatisfactory. Now they are made of a special fabric-filled plastic and are molded in two halves with a crosswise split. The filler used in the housing plastic is nothing more than clipped Army shirt tails.

Replacements for mica are being developed from a new plastic which can be more closely controlled in manufacture than mica and should be of value in insulation.

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